IMPROVED ENERGY TECHNOLOGIES FOR RURAL CAMBODIA

The World Bank

Ministry of Industry, Mines and Energy

gender equality as smart economics

ESMAP
Energy Sector Management Assistance Program

ASTAE
Asia Sustainable and Alternative Energy Program

Overview

Many Cambodians in rural areas use kerosene for lighting, "three stone stoves" for cooking, and drink water from rivers or ponds. Wood and charcoal are the primary energy sources, and almost all electricity is generated from imported diesel. To address this situation, four new efficient, cleaner, and affordable energy technologies have been tested and are now ready to be widely disseminated.

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Approximately 80 percent of Cambodians live in rural areas with limited access to clean and affordable water and energy. Thirty-four percent of the rural population live below the national poverty line on less than 2,367 riels ($0.60) per day.

Even though Cambodia is a low-income country, the cost of electricity is one of the highest in the world due to limited domestic energy resources. Even when available, rural households pay more for electricity than urban residents. Currently, only 6 percent of Cambodia's rural population has access to electricity, mostly from village grids which are often powered by inefficient diesel generators; and 80 percent use kerosene lamps or florescent lights powered by car batteries.

Over 90 percent of energy used for cooking comes from wood and charcoal, contributing to increased deforestation. Due to the inefficiency of the commonly used energy technologies such as traditional cook stoves and kerosene lamps, the poor pay higher unit costs for energy than more affluent people. On average, rural families spend about 10 percent of their income on fuel and electricity.

Many of the 13,000 villages in Cambodia have battery charging stations powered by diesel generators, and more than half of rural households have batteries charged about 5 times a month at a cost of $2.5 per month.

The poor also spend about three to four hours a day on energy-related activities such as gathering fuel wood, boiling water, and cooking. The use of more energy-efficient and renewable energy technologies could significantly reduce the large share of household expenses currently required for cooking and lighting, allowing poorer people to save more money for food, education, and health services.

Inadequate access to energy services has entrenched poverty, slowed improvements in health and education, and contributed to environmental degradation and socio-economic inequalities.

If we want to reduce rural poverty, improving access to clean and affordable energy services is a prerequisite for achieving economic, social, and environmental benefits, and for meeting development goals. Also, renewable and energy- efficient technologies significantly reduce greenhouse gas emissions, playing an important role in the global fight against climate change.

In the remote rural areas where many Cambodian's live, extending the electricity grid is not cost effective, but these rural households can still benefit greatly from small-scale off-grid solutions. Simple, small, and cost-effective cleaner energy technologies can make a big difference in the lives of the poor – especially the women and children, Meeting the energy needs of poorer communities requires focusing on the needs of the end-users. This requires providing energy services that are useful, appropriate, and affordable.

Bottom-up consultations identify and deliver the kinds of energy services needed to meet local demand and evaluate results. Project outcomes are more likely to be sustainable if the intended beneficiaries are consulted directly and participate in management.

In addition, sustainable business models that include creative payment schemes for households will help make these technologies affordable even for the poorest people.

With support from the public and private sector, including technical assistance from the World Bank Energy Sector Management Assistance Program (ESMAP), the Asia Sustainable and Alternative Energy Program (ASTAE) and the active involvement of NGOs, small and medium-sized enterprises are working to develop creative business models and payment schemes so that poorer households can access these energy efficient and renewable technologies and improve their livelihoods.

This booklet provides an overview of four improved energy technologies piloted in rural Cambodia so that policy makers can get a better understanding of their benefits and the positive impacts they make on the livelihoods of the rural poor.

Rural families consume approximately 5kg of firewood per day – in total about 5 million tons per year is used for cooking.

Efficient Cook Stoves

In Kampong Speu alone, over three thousand families make their income from selling wood, and five thousand families from charcoal production.

More than 90 percent of total household energy used in rural Cambodia comes from wood and charcoal, which will continue to be the primary energy source for many more years, especially for poorer people. Faced with this reality, it is clear that simple and affordable solutions to the problems associated with burning wood and charcoal should be addressed. One obvious solution is the production and wide dissemination of more efficient stoves, which can cut fuel consumption in half.

Efficient cook stoves have been successfully introduced to about 40 percent of the urban population. However, in rural areas most households are still using the traditional "three stone stove", even though new, energy-efficient stoves can save up to 60 percent on fuel. Although more energy-efficient stoves cost only one or two dollars more than traditional ones, the poorest households still cannot afford them without a subsidy or installment payment scheme.

There are two models of improved cook stoves: the Neang Kongrey stove and the New Lao stove. The Neang Kongrey is a simple ceramic cook stove that sells for about $1.25 and lasts for 1-2 years. The New Lao Stove has metal cladding and insulation that adds at least two years to the stove's lifetime and increases its cost to about $4.

The new, improved cook stoves are based on traditional stove models, but both are more efficient due to three main improvements in design: 1) the space between the pot and the pot-rest is reduced, 2) the grate has smaller holes, and 3) the combustion chamber is smaller. The effect is better combustion with less heat loss, a more complete burning of wood, and also less smoke.

New Lao Stove

Neang Kongrey Stove

Ox carts are the traditional means of distributing cook stoves throughout the country – a trip often takes 2 to 3 weeks.

The efficiencies of the NKS and NLS are similar, at about 30%. They use approximately 21% less fuel wood than a Traditional Lao Stove and 64% less than a "three stone stove".

Because of the significant savings on charcoal and wood, payback time is about one month for the Neang Kongrey Stove and three months for the New Lao Stove.

Both stoves are very popular with users because they significantly cut cooking fuel consumption. For those who collect and chop their own wood, using less fuel saves them considerable time. Women and children also benefit from the reduced smoke that often causes respiratory diseases. Users also appreciate the new stoves because they hold the heat well and do not require too much attention, so that cooks can do other things after putting a pot on the stove. Users also say they save time because food cooks faster. The choice of stove depends on family needs, size of their pots (as the stoves come in different sizes), portability, and how much the family can afford to pay.

More efficient cook stoves provide global environmental benefits by reducing greenhouse gas emissions from the combustion of biomass. These emission reductions, approximately 0.3 to 0.5 tons of carbon dioxide per stove per year, can generate a significant amount of carbon credits, providing the sustainable financing necessary to implement a self-sustaining national cook stove program, as well as financing the sustainable production of sufficient firewood through community woodlots and efficient charcoal production.

To improve quality, durability, and increase production capacity (the problems found during a pilot dissemination of 8,000 stoves), the World Bank-ASTAE Program provided GERES-Cambodia with the technical assistance required to develop a model production facility for Neang Kongrey stoves.

This facility mixes clay mechanically and provides improved molding techniques, and kiln firing. In addition to producing more and better quality stoves, as compared to traditional production methods, this enterprise also pays fair wages to stove producers, most of whom are women. Due to the improved efficiency of production, the facility keeps costs low so that poorer people can afford to buy the stoves.

The Model Production Facility considered the needs of the women producers – and they now have the option of forming and molding the stoves at home, with the clay mixed in the facility and stoves fired in the facility's kiln. This enables them to take care of the children, house, and animals while earning money working on the stoves.

The Model Production Facility is located in Banh Chhkoul village, Kampong Chhnang Province, Cambodia's center for stove and pottery production and distribution.

The village's 60 ox carts, 15 motorized carts (remorks), and 8 small trucks transport pottery and all kinds of traditional, as well as the more efficient stoves, to major towns and district markets in provinces around the Tonlé Sap and in the Mekong River delta.

The Model Production Facility gives a promising future to the village whose traditional, inefficient stoves were losing their market share.

Biodigesters

Biodigesters can eliminate the need for fuel wood, and significantly reduce the expense of kerosene for lighting.

The benefits of biodigesters are highly appreciated by both women and men. They improve the living conditions of the entire family and contribute to their farm's productivity.

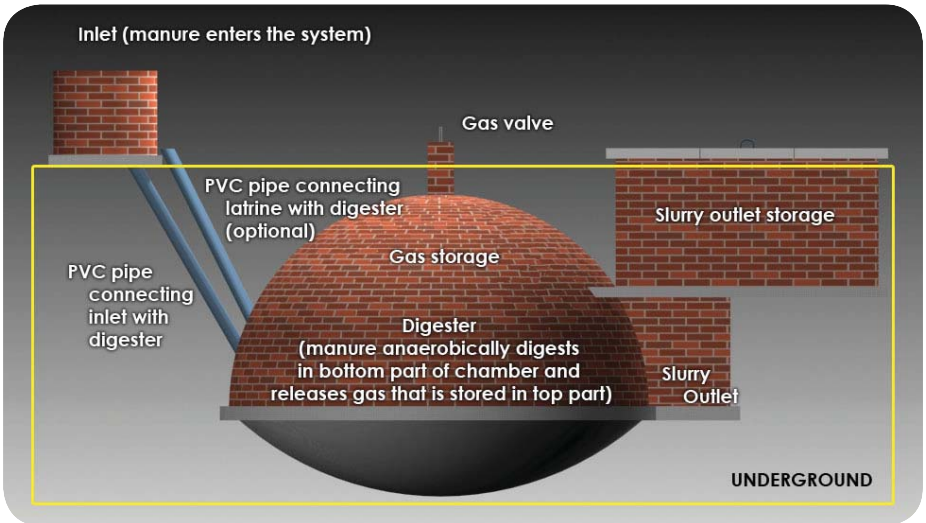
Anaerobic biodigesters, fed with animal dung and other organic waste, produce methane gas which is used for both cooking and lighting. Rural families with four or five cows or about 10 pigs have sufficient dung to produce enough gas to cook three meals a day for a family of six, and also sufficient gas for an entire evening of lighting.

Biodigesters help to reduce deforestation, eliminate harmful indoor smoke from wood fires, reduce greenhouse gas emissions, improve sanitation in and around the house, and make home study and income generation activities possible beyond daylight hours. Each biodigester can reduce CO2 emissions by about 6 tons per year.

The smokeless and very clean kitchen is especially valued by women, and the slurry is highly valued as a natural fertilizer by men. Both appreciate the overall benefits to the family that come from saving fuel wood and having a more hygienic environment around the house, and in the pig sty and cattle pen.

Biodigesters empower women and significantly reduce their workloads. By replacing the use of firewood with biogas for cooking, women and children spend less time collecting cooking fuel which allows women to be more productive, and children the time to attend school. Through time saved in firewood collection, chopping, and starting fires, the biodigester reduces the workload of women and children by approximately 2-3 hours per day.

Changing from fuel wood to biogas for cooking reduces smoke and indoor air pollution. Indoor air quality



" I used to pay a lot each month for LPG gas and often had to cook with firewood or charcoal that made my pans very dirty. Now I have biogas and I can use my LPG stove with the biogas. The cooking quality of the gases is the same, but now the gas comes from the waste of the cows and is free ".

"I used to collect fuelwood and now I don't have to with a biodigester, I am able to save several hours a day and the cooking is much easier and cleaner."

"I used to have very irregular work as my boss only called when we needed to build a biodigester. Now my boss started a company and we can find clients ourselves and can build many more biodigesters than before."

is a major public health concern, as it is shown to cause and/or exacerbate a wide array of health problems: asthma, low birth weight and still birth, early infant death, chronic obstructive lung disease, blindness, tuberculosis, heart disease, and others. This is more pronounced among women and children in the rural areas of developing countries, as they tend to spend more time indoors cooking with primitive stoves. Other major health hazards related to wood burning are fires in kitchens, poor ergonomics of cook stoves, and severe backache due to carrying heavy loads of wood. Again, mostly women are affected.

Improved local environments and health conditions are also expected for those households that choose to connect their latrine to the biodigesters. This type of connection will result in better disposal of human waste, and is expected to improve health conditions by improving drinking water quality, particularly in areas that flood.

Compared to cooking with firewood, biogas cooking is so easy that families are now making more dishes during the day, such as frying eggs, and use it for heating water for hot showers. The ability to turn on the gas tap and quickly cook a number of dishes should improve nutrition. By comparing the kitchens using firewood with those using biogas one can see the incredible improvements the biodigester can make to living standards, especially for women and children.

The National Biodigester Program (NBP), hosted by the Ministry of Agriculture, Fisheries and Forestry, with technical assistance from SNV-Cambodia, is developing a commercial market-oriented biodigester sector. The World Bank-ASTAE Program also provided technical assistance to the NBP to support the training of local companies to provide sales, installations, warranties, and the supply of spare parts.

Ceramic Water Filters

Ceramic water filters not only improve sanitation and the safety of drinking water, but also save time and reduce the fuel consumed in boiling drinking water.

Rural families get their drinking water from rivers, lakes, ponds, and deep drilled wells. Before drinking, most families boil the water, but they often drink the water directly from the source, resulting in many cases of diarrhea and other intestinal diseases.

Water from open wells, rivers and lakes can be filtered with ceramic water filters to produce a much safer drinking water. International studies show that the ceramic water filters, on average, eliminate 95 percent of all bacteria and viruses, and reduce diarrheal diseases by 46 percent in rural areas.

In parts of Cambodia, especially in Kandal Province, many deep water wells are polluted with dangerous levels of arsenic. While the ceramic filter cannot remove arsenic and other chemical contamination, surface water can be used instead in these affected areas.

Resource Development International – Cambodia (RDI) has been making ceramic water filters in Cambodia since 2003 and has distributed over 75,000 units in Cambodia and internationally.

The ceramic water filter is produced from clay mixed with powdered rice husks, kiln fired, and then impregnated with a silver nitrate solution that kills bacteria. The cost of the filter is $10, and the payback time is about 3 months for people who buy wood to boil water. Each filter can reduce carbon dioxide emissions by 0.5 tons per year by eliminating the combustion of fuel wood for boiling water. The filter can last for at least two years if regularly cleaned and properly used.

The water filter is appreciated not only for reducing the burden of collecting fuel wood, or the cost of paying for it, and the time spent boiling water, but also because the filter saves on the medical expenses of treating water-born intestinal diseases. The filter users and neighbors who drink their water say that "the filtered water is delicious, and it encourages us to drink more water, which is important for good health."

LED Lanterns

An LED lantern with a photovoltaic charger is a sustainable solution for rural lighting needs

In rural areas, about 80 percent of households use a kerosene lamp for lighting. For many of the poor, this is their only lighting source, but even the middle class and more affluent households use kerosene because local grids do not provide electricity 24 hours a day, and florescent lighting powered by rechargeable car batteries is more expensive.

LED lights consume much less energy than incandescent bulbs, which makes the lantern more efficient. The LED lantern, promoted by the NGO, Resource Development International-Cambodia (RDI), has several functions: a bright flashlight with a high and a low beam, and 10 LED lights on the side that can be used for evening activities such as eating dinner and study. The strong side light can last for about 12 hours on a fully charged battery, and the flash light at low beam lasts for about 25 hours.

The battery can be charged from the grid, from a 12-volt battery by using an adapter, or by using a small photovoltaic solar panel. The lantern has a 4-volt battery with 5.5 ampere capacity and sells for about $15. The solar panel is 2.5 watt / 6.6 volt, with an expected lifetime of more than 10 years. The cost for the solar panel is $18. The payback time is expected to be one year (for families replacing their kerosene lamp with both the LED lantern and solar panel).

Villagers value the LED lantern for a variety of reasons. The strong headlight is useful for guarding their livestock in the forest or around their houses. Many villagers have had their livestock stolen, and greatly appreciate the powerful high beam that discourages thieves. The high beam is also used for catching frogs and fish after dark, which reduces daily food expenses.

The sidelight is used for preparing and eating dinner, children's study, getting ready for bed, and for income generation activities after daylight hours. The flashlight is convenient for visiting neighbors after dark and sudden needs such as a baby crying or checking on sounds from outside. The portability of the lantern is also appreciated because it can be moved around the house and up and down the stairs much more easily than a florescent light attached to a battery.

If the lantern is to benefit poorer households by replacing kerosene lamps as the primary house lighting, the retailing price has to be made affordable through rent-to-own arrangements. Households which use kerosene from sunset to bedtime spend an average of $2 to $4 per month. Therefore, two or three dollars per month, for rent-to-own installments, is considered affordable by poorer households.

To make the water filters and lanterns available in rural villages, RDI sponsored business training and selected 25 interested villagers to become retailers.

They followed a three-week training course during which they gained basic accounting and entrepreneurial skills, including promotion and finding potential customers. These entrepreneurs designed several payment schemes including an option for rent-to-own in order to make the technologies available to the poor.

From their experience they found that poor households are able to pay a daily payment, for either the lantern or filter, equal to what they currently spend on kerosene for lighting or wood for boiling water.